Volume 43 AUGUST, 1957 Number 8

Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

This Issue

AUTOMATIC GREASE DISPENSING EQUIPMENT

PUBLISHED BY
THE TEXAS COMPANY
TEXACO PETROLEUM PRODUCTS

LUBRICATION

A TECHNICAL PUBLICATION DEVOTED TO THE SELECTION AND USE OF LUBRICANTS

Published by

The Texas Company, 135 East 42nd Street, New York 17, N.Y.

Vol. XLIII August, 1957 No. 8

AUTOMATIC GREASE DISPENSING EQUIPMENT

THE FINEST bearings ever designed to speed machine operation can become liabilities unless their load surfaces are shielded by a continuous film of lubricants. Even the highest grade lubricant will fail to provide this protective friction-reducing film between load surfaces unless it is applied in a suitable quantity at the proper time. Automatic grease dispensing systems have provided a means for positive and uniform distribution of lubricants to all points, including many moving parts which would otherwise be relatively inaccessible. Their use was pioneered by the iron and steel industries, but has spread to almost every type of industrial equipment.

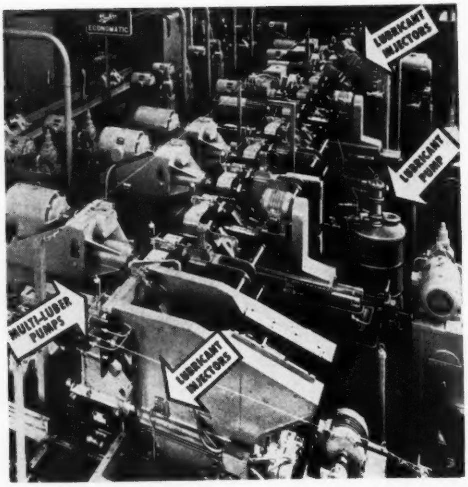
From the earliest use of the hand operated grease cup, the builders of lubricating equipment have proceeded to design and perfect other ways of controlling and impelling grease to the various points of delivery. The development was in line with the following order:

1. — The hand-operated grease cup.
2. — The pressure gun.
3. — The spring type grease cup.
4. — The power driven grease lubricator.
5. — Multiple tube and floor level lubrication.
6. — Centralized pressure.
7. — Completely automatic grease dispensing systems.

These various systems may also be thought of as being grouped according to hand lubrication, centralized lubrication and automatic lubrication.

Hand lubrication, the earliest method of lubricating machinery, employed oil holes, grease cups, and later pressure fittings and hand guns. This method often required that the machine be shut down while it was lubricated, resulting in substantial losses and curtailed production. Although still used, hand lubrication usually means that the conveniently located, easy to reach bearings are "flooded" and generally result in wasted lubricant. Hard-to-reach bearings are frequently overlooked, resulting in bearing failures and machine breakdowns—extremely costly from the standpoint of new parts, the labor in making repairs, and loss of production while the machine is out of service.

Centralized lubrication, although sometimes referred to as "the latest development", is really only the second step in the development of lubricating science. The earliest centralized systems consisted of lines running from bearings to some easily accessable centralized point, so that all the bearings could be "shot"—one after another—by someone standing in one location. This relieved the oiler of



Courtesy of Lincoln Engineering Company

Figure 1 — All moving parts of this complex installation which performs 55 operations every 23 seconds are automatically power lubricated at predetermined intervals.

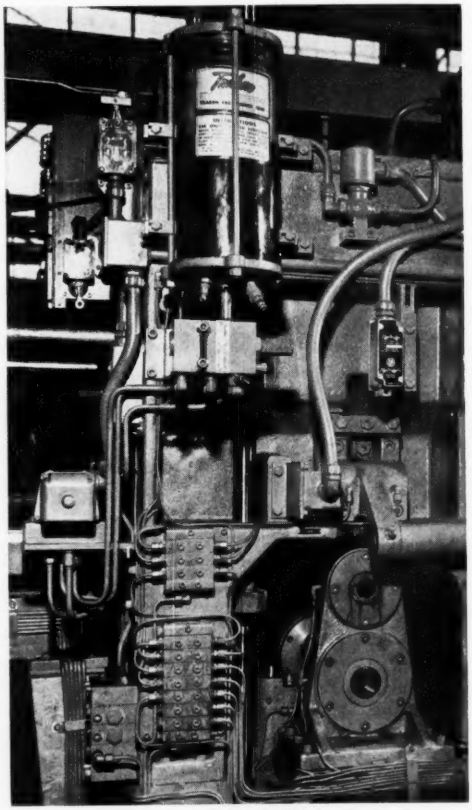
the need of climbing around the machine and frequently permitted the machine to be lubricated while is was in operation. In practice, however, the oiler might over lubricate the bearings to insure adequate lubrication. The sides of the machine were sometimes coated with excess lubricant, resulting in high grease bills, and—in the case of ball and roller type—the bearings might be packed so full of lubricant as to resist, instead of aid, the transmission of power.

The next step in "centralized" lubrication was the introduction of measuring or metering devices called "feeders". These feeders were mounted on a machine at convenient places. Lines were run from the feeders to the bearings, and the feeders were connected together into a common circuit. Lubricant was then introduced into the system from some easily accessible point with a grease gun, grease pack or barrel pump, etc., and the feeders made certain that the proper amount of lubricant was delivered to each bearing. It was still necessary, however, for someone to make the rounds from one machine to another to operate the pump apparatus. This hand system still leaned heavily on the human factor. If the oiler came around too often the bearings got too much grease. If he came around too infrequently the bearings got too little grease. While it was a major improvement over oil hole and grease cup lubrication, the centralized systems served principally as a transition step between hand and the now widely used automatic lubrication.

Automatic lubrication, the latest development of lubricating science, has made possible many savings and economies and has assured positive and optimum lubrication. It is the purpose of this article to discuss some of the aspects of automatic grease dispensing systems that are in current use. Also of interest are the various types of laboratory bench tests that have been used to predict pumpability characteristics of greases used in these automatic dispensing systems.

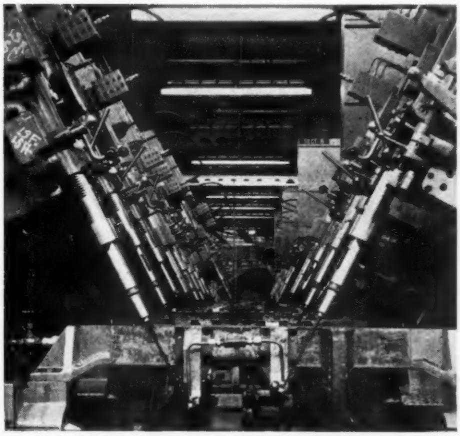
Users of Automatic Lubrication Systems

Automatic lubrication systems are used in almost every imaginable type of application employing bearing surfaces. To name a few, they have been used in the iron and steel industry, metal forming processes, automotive industry and all kinds of industrial machine operations. They have also been used to lubricate equipment used in the coal mining, textile, rubber, cement, cannery and paper industries and in many other applications. Space does not permit complete coverage of each type



Courtesy of Trabon Engineering Corp.

Figure 2 — Combination automatic grease and oil lubrication on a machine tool.



Courtesy of Trabon Engineering Corp.

Figure 3 — Automatic drilling machines lubricated by Trabon system.

application but an attempt will be made to illustrate and discuss some of the representative systems.

It is fairly well accepted that the use of automatic or centralized lubrication systems does result in net savings for the user. These savings follow from less downtime for repairs, savings in actual lubricant consumption, elimination of downtime for lubrication, and savings in replacement parts. In many cases, however, the proponents of the centralized systems have had an uphill fight. On new equipment, high labor installation costs often add up to more than the material and engineering. Where other systems are already in use, there may be reluctance to make a changeover to more expensive lubricating systems. One or two breakdowns, however, on critical pieces of machinery due to inadequate lubrication very often starts the ball rolling toward the use of automatic grease dispensing equipment. In view of the many advantages and possible savings, it is interesting to note that it is estimated that the suppliers of centralized lubrication equipment are getting only 25 per cent of the business potential.

GENERAL CHARACTERISTICS

Automatic grease dispensing equipment may vary widely in design but all systems generally have the same basic features. These features are: (1) a pump or some other positive means of delivering lubricant from a reservoir, (2) a distribution system of piping or tubing, (3) measuring or metering devices which regulate the amount of lubricant that is applied to each bearing and (4) an automatic timing device to regulate the entire system. Thus, except for filling the reservoir, dependence on the human element to lubricate the equipment has been eliminated.

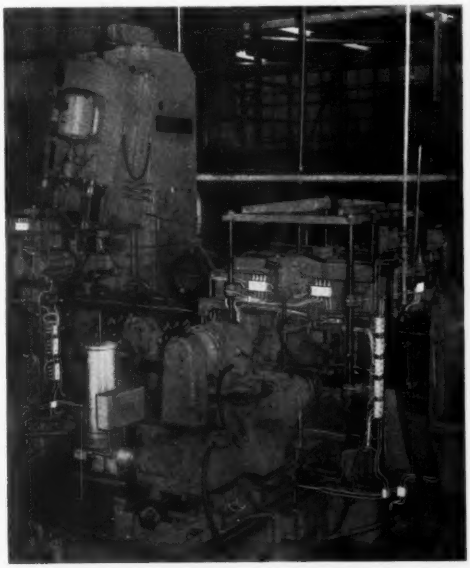
The pump may be powered directly by the machine itself or by some independent means. Likewise, the timing device may be tied into the cycle of some moving part of the machine or it may be regulated by a clock-like mechanism. The reservoirs are usually equipped with a follower plate or impeller to insure positive feed of the grease to the pump.

Basic Systems

Two basic types of valving systems have been generally used. These two systems are the series and parallel type. The series systems have valve pistons located "in" the lines. The parallel systems have valve pistons located "off" the transmission lines. In order to transmit the lubricant in a series system, it is necessary that each valve piston make a full and complete stroke. In the parallel system, the action of the valve pistons does not affect the transmission of the lubricant throughout the system.

Series Types

In the series system, valve pistons are moved progressively for a complete stroke under full pump volume and pressure. There are two common design variations of this type system. Either manifolded or reversing type series systems can be used. The manifolded series employs an internal porting arrangement to bring alternating pressure to bear



Courtesy of The Farrel Corp.

Figure 4 — Automatic grease dispensing system servicing transfer machine.

TABLE I

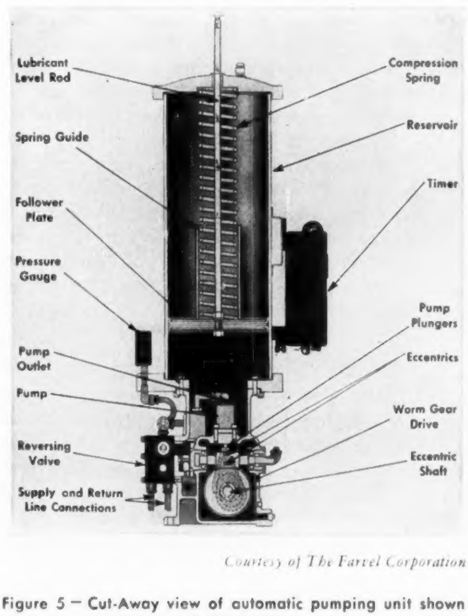
Series or Sequence Type	Parallel or Header Type
1. Fluctuating pressure at the pump gage, developed as necessary.	1. Fixed maximum pre-set pressure at pump or end of line.
2. Full pump discharge volume and pressure exerted directly against each valve piston.	2. Pump discharge volume and pressure exerted in the header line with valve pistons operating as this pressure exceeds resistance to piston movement.
3. Pump is connected directly and individually to each bearing port in sequence.	3. Pump is connected to all valve pistons simultaneously as the header pressure reaches its maximum.
4. Bearings are lubricated in progressive sequence regardless of resistance to flow in the piping system and bearings.	4. Sequence of application of lubricant to bearings depends upon resistance to flow in the piping system and bearing, valve piston moving against lowest resistance operates first, etc.
5. Each valve piston must make a full stroke for continued system operation.	5. Valve pistons may make full, partial or no stroke without affecting system operation.
6. Comparatively small main lines for transmission of lubricant.	6. Comparatively large main lines for transmission of lubricant.
7. Low volume lubricant pumps to reduce dynamic head.	7. High volume lubricant pumps to bring header lines to pre-set pressures quickly.

against either end of the valve piston. This does not require any device or means at the pump to reverse the flow of lubricant. In the reversing type series systems, the lubricant first flows in one direction and then reverses flow to return the valve piston to its original position.

Parallel Type

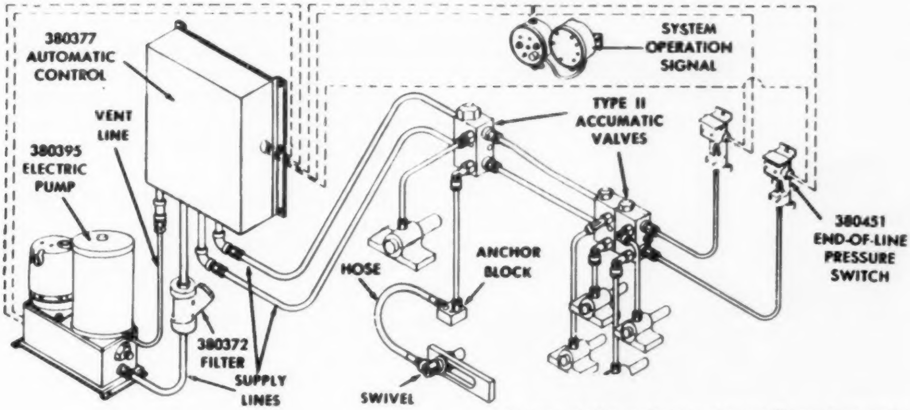
There are two common design variations of the parallel or header type systems. Two-line header systems can be used in which the valve piston is returned by the use of alternating hydraulic pressure on either end of the piston. The individual metering valves supplying lubricant to the bearings are connected to both of the two supply lines. The lubricant flows alternately in one supply line and then the other. In the single line header systems the metering valves are supplied by lubricant flowing in one direction in a single line. The valve pistons in the metering valves are returned to their original position by means of a spring. Means are usually provided to indicate when a piston stroke was made and the extent of the stroke.

A summary of the operational characteristics of the series and parallel type systems is shown in Table I.



Courtesy of The Farvel Corporation

Figure 5 — Cut-Away view of automatic pumping unit shown in Figure 4.



Courtesy of Alemite Division, Stewart-Warner Corporation

Figure 6 — Schematic of Alemite Type II System.

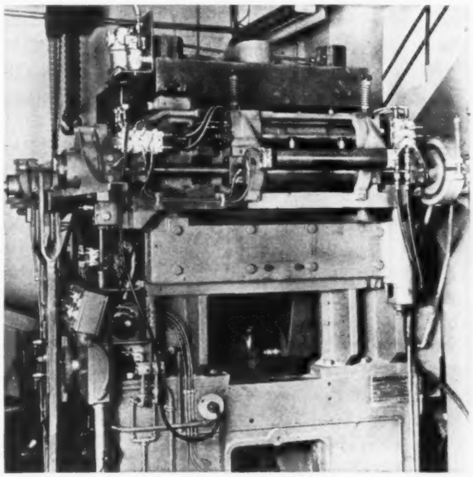
Some automatic systems have been in use and have given outstanding performance for several years. One such system is illustrated in Figure 5. This system is designed to supply either grease or oil to single or multiple machine applications and can be obtained in medium-sized or heavy-duty pumping units for use in "loop-type" systems.

The complete arrangement consist of the central pumping unit, two main supply lines, and a measuring valve for each bearing point. The two main supply lines reach all valves, forming a complete circuit and return to a four-way hydraulic reversing and control valve. Location of this pressure control mechanism at the return end of the main supply lines forces the lubricant to traverse the entire system and develop sufficient pressure to operate all valves before the reversing valve will function to redirect the flow into the other main line. Pump and line pressure gages check system operation. System versatility is increased not only through the availability of a number of the type central station modifications but in the adjustment features of the measuring valves and reversing valve as well.

Cycle frequency of system operation is controlled through an electric time clock which provides a simple, adjustable means of energizing the unit. The system shut-off is accomplished automatically by a limit switch actuated by the reversing valve at the end of the cycle. Suitable single devices — reset timers connected to horns or warning lights—are available to provide an indication of any interruption in the normal operation of the system.

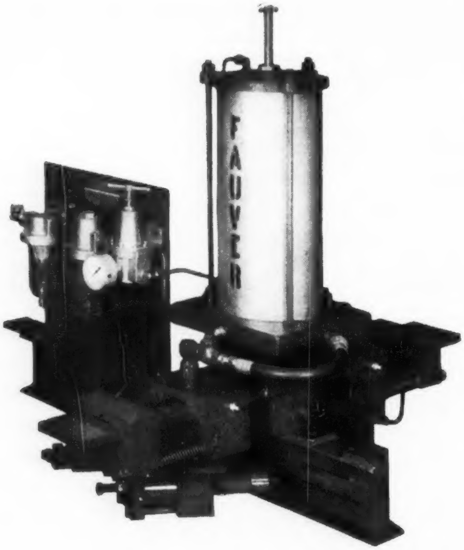
Automatic Conveyor Lubricators

An example of a lubricator designed to apply automatically a controlled volume of lubricant to wheel bearings of conveyor trolleys is shown in Figure 8. These units can handle a wide range of lubricants from light oil to heavy greases. The lubricator is a self-contained unit which is mounted on the trolley rail and actuated by the moving conveyor. There is a single pumping unit for each side of the rail. The lubricator illustrated requires only compressed air for its operation. As a trolley wheel approaches the lubricator, the hub engages the nozzle of the pumping unit which is then automatically brought into contact with the grease fitting. The trolley wheel carries the nozzle with it and when the nozzle is pointing straight at the trolley, a measured quantity of lubricant is dis-



Courtesy of Alemite Division, Stewart-Warner Corporation

Figure 7 — Punch press using combination Type II and oil mist systems.



Courtesy of J. N. Fauver Co., Inc.

Figure 8 — Automatic Conveyor Lubricator.

charged under pressure into the wheel bearing. The nozzle is carried slightly beyond this center position and then released on the trolley to return to its pickup position. At the time the lubricant is discharged, the nozzle is tightly sealed against the grease fitting, thus preventing any leakage. Each pumping unit is adjustable as to the quantity of lubricant discharged into each wheel bearing.

The lubricant is supplied from the reservoir at a constant pressure. The follower placed in the reservoir is subjected to just enough air pressure to give a constant, steady supply of lubricant to the pumping units. Air pressure in the reservoir is varied in accordance with the viscosity of the lubricant.

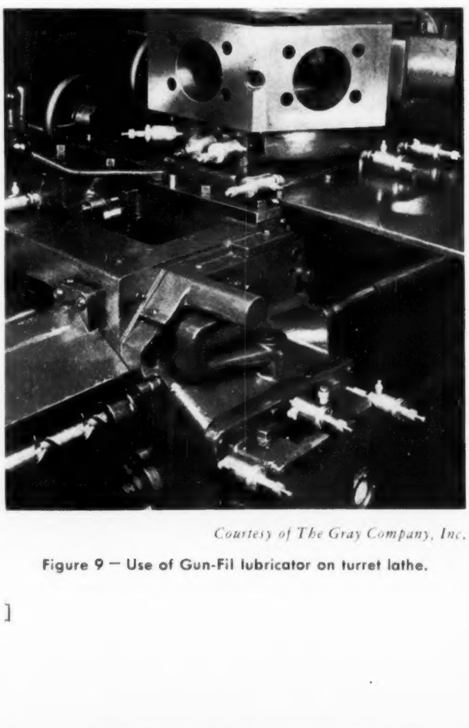
Individual Automatic Units

On some pieces of machinery, various bearings may require different types of grease. It may also be inconvenient to have feeder lines coming to the machine. In such installations, an individual automatic type lubricator is very useful. These individual lubricators come in various sizes and insure that the exact amount of grease is dispensed to provide the proper function of each individual bearing. An example of one of these individual lubricators is shown in Figure 10. They can be filled by applying a grease gun to the fitting on the lubricator. As the grease enters, it forces the piston and flow control valve up until the spring is fully compressed. The lubricant feed is controlled by adjusting the travel of the flow control valve. Backing-off the valve restricts the flow for a longer time, preventing excess delivery. If the grease feeds too rapidly or too slowly to meet the operating requirements of a bearing, a change to a flow control valve having greater or lesser resistance can be made. Valves can be changed quickly without the use of tools or without disassembling the lubricator.

LABORATORY INVESTIGATIONS

In each of the systems just discussed, satisfactory operation is dependent to a large extent upon the selection of the proper lubricant. The grease not only must be capable of providing good lubrication once it reaches the point of application, but it must also have good pumpability characteristics. Pumpability of a grease may be defined as that property which indicates how readily it can be handled in a grease dispensing system over a given temperature range. Similar greases may have widely different pumpability characteristics, and it is important to know what the limitations are when selecting a grease for a given system.

Pumpability data on any grease can be best obtained by laboratory study where operating conditions can be simulated and properly controlled. To conduct large scale pumping tests at various conditions for each lubricant, however, would be a time consuming and expensive proposition. It would, therefore, be very valuable if some standard laboratory apparatus that would correlate with pumpability could be used. A considerable amount of work has been done to correlate pressure viscosi-



Courtesy of The Gray Company, Inc.

Figure 9 — Use of Gun-Fil lubricator on turret lathe.

meter results with pumpability. Various mock setups of centralized lube systems have also been used to obtain predicted performance data.

Correlation of Pumpability With The Pressure Viscosimeter

The pressure viscosimeter measures apparent viscosity and is very similar in principle of operation to a centralized lubrication system. Before entering a discussion of this work, however, a brief discussion of viscosity is in order. Viscosity may be defined as the internal friction of a fluid or that property which causes resistance to flow. The viscosity coefficient of a fluid may be defined as the ratio between the shearing stress acting upon a unit volume and the corresponding rate of shear. When the value of this ratio changes with the shearing stress, the fluid is described as showing non-Newtonian flow. Greases are known to be non-Newtonian and, since their viscosity changes with the rate of shear, they possess no true viscosity coefficient. For materials which behave in this manner, the term "apparent viscosity" is applied to the ratio of the shear stress to the rate of shear.

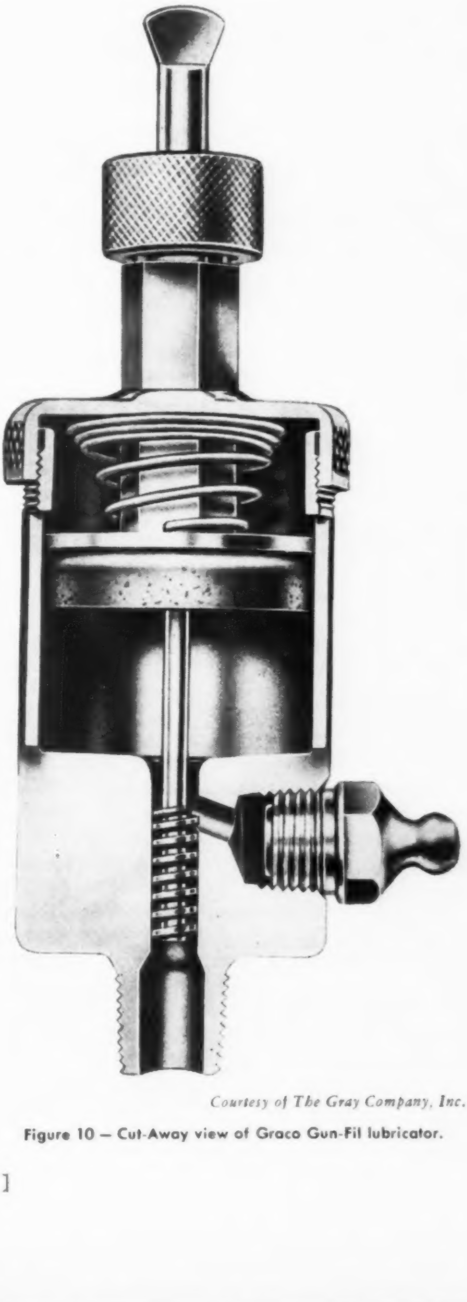
For the correlation work, apparent viscosity data at various temperatures were determined for several greases in the pressure viscosimeter using the standard ASTM procedure. These same greases were then tested in a mock setup of a centralized lubrication system. Each grease was pumped through various lengths of ¼, ⅜ and ½ inch copper tubing. Various combinations of ells and tees were also used. In addition, the greases were pumped through a four-section commercial header block. The data obtained in the setups were the various flow rates and their corresponding pressures at each test temperature. Since the end of the tubing discharges at atmospheric pressure, the total pressure observed at the entrance of the tubing was actually the pressure drop.

Prior to making the actual pumping tests on the greases, the effective diameters of the copper tubing were determined. This was done using a heavy straight mineral test oil and the Poiseuille equation shown below:

$$u = \frac{\pi P r^4}{8 L v/t}$$

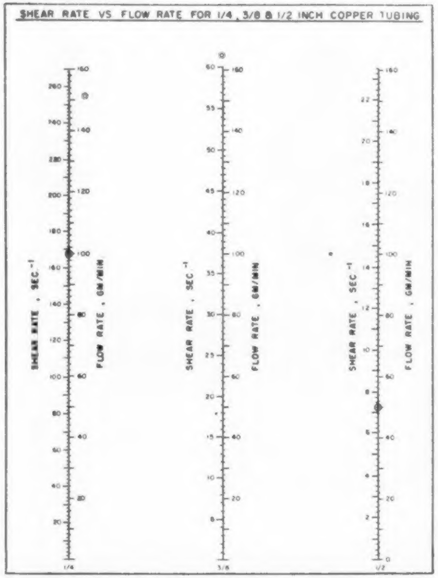
u = absolute viscosity (centipoises)
P = pressure (dynes/cm²)
r = radius of tubing (cm)
L = length of tubing (cm)
v/t = flow rate (cc/sec.)

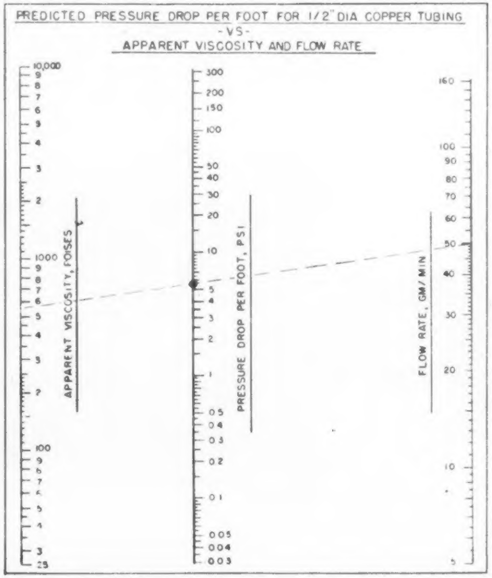
Using an oil of known viscosity and several different flow rates and pressures, the average value for r, and thus the effective diameter for each size tubing, could be determined. From this work, it was found that the effective inside diameters of the ¼, ⅜ and ½ inch tubings were 0.183, 0.303 and 0.415 inch respectively. Using these values, the effective shear rate for various flow rates in each size tubing could be calculated (Shear Rate = $\frac{4 v/t)}{r^3}$.

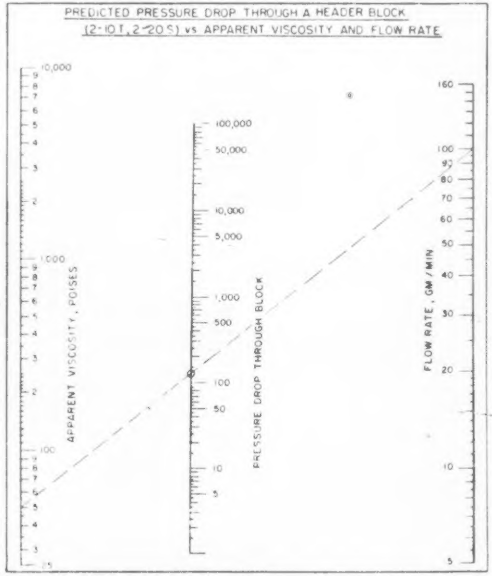


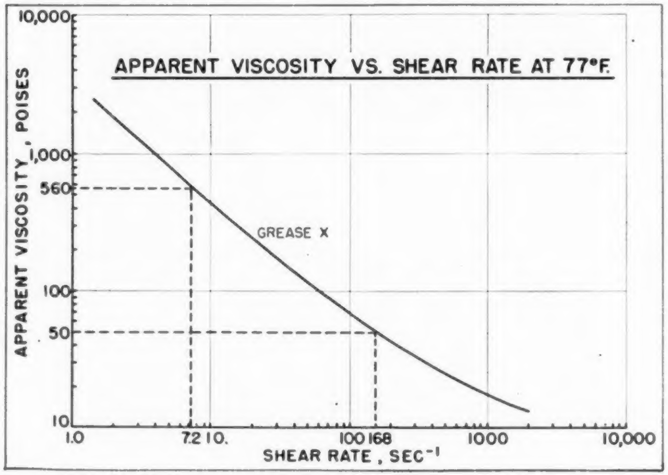
Courtesy of The Gray Company, Inc.

Figure 10 — Cut-Away view of Graco Gun-Fil lubricator.









Use of nomographs constructed from laboratory work to predict pressure drop in centralized system tubing and header block.

Example 1. Determine predicted pressure drop per foot for Grease X when pumped through ½ inch diameter tubing at flow rate of 50 grams per minute and 77°F. Solution: In Figure 11 (upper left), find that flow rate of 50 grams per minute gives shear rate of 7.2 sec.$^{-1}$. From apparent viscosity curve in Figure 14 (lower left), determine that grease has apparent viscosity of 560 poises at this shear rate. In Figure 12 (upper center), draw line connecting apparent viscosity and flow rate values; intersection of line with pressure drop scale gives predicted pressure drop of 5.6 psi per foot.

Example 2. Determine predicted pressure drop through Trabon header block for Grease X at flow rate of 100 grams per minute and 77°F. Solution: In Figure 11 (upper left, use ¼ inch diameter tubing scale to get estimated shear rate of 168 sec.$^{-1}$ for flow rate of 100 grams per minute. From apparent viscosity curve in Figure 14 (lower left), determine that grease has apparent viscosity of 50 poises at this shear rate. In Figure 13 (upper right), draw line connecting apparent viscosity and flow rate values; intersection of line with pressure drop scale gives pressure drop of approximately 130 psi.

With the above information available, curves were plotted of flow rate versus pressure drop per foot for each of the greases at each of the test temperatures at which determinations were made. It was found that the pressure drop through three ells or three tees of any diameter was approximately equivalent to the pressure drop through one foot of tubing of the same diameter. In calculating pressure drop through tubing containing ells or tees, the proper correction factor was used.

Nomographs were then constructed relating flow rate to shear rate (shown in Figure 11) and flow rate to pressure drop per foot of tubing and to the apparent viscosity of the grease determined in the pressure viscosimeter (shown in Figure 12). These nomographs were constructed for each diameter tubing tested.

Header Block

The header block on which most of the work was conducted consisted of four distributing blocks, two 10-T block sections and two 20-S sections. The block numbers designate the amount of lubricant discharged in thousandths of a cubic inch per stroke of the piston, and the letters represent the number of outlets (S = single outlet, T = two outlets). Thus, a 10-T block section indicates that for each stroke of the piston, 0.010 cubic inch of lubricant is discharged through each outlet.

The header block was connected to the grease cylinder by five feet of ¼ inch diameter tubing. Several greases were pumped at flow rates of 10, 20, 35, 50, 70, 100 and 120 grams per minute at temperatures of 32, 50 and 77°F. Data were obtained on several greases using a four-section header block (two 10-T, and two 20-S). In addition, limited data were obtained on various combinations of header blocks up to an eight section block (two 10-T, two 20-S, two 30-S, two 10-S).

The nomograph for the predicted pressure drop through a header block (two 10-T and two 20-S sections) illustrated in Figure 13 was constructed by the same method that was used in constructing the nomographs for the various size tubings. First, the raw data were plotted to get a group of curves of flow rate versus pressure drop through the header block at the various temperatures. The second step consisted of using these curves to plot additional curves for each of the greases of pressure drop through the block versus apparent viscosity at constant flow rates of 10, 20, 35, 70, 100 and 120 grams per minute. Each of these curves incorporated data obtained at three temperatures: namely, 32, 50 and 77°F. The apparent viscosity used in the second set of curves was equivalent to the apparent viscosity found at shear rates in the ¼ inch diameter copper tubing at the various flow rates. It was felt that this would be desirable since it would be very difficult to calculate the true average shear rate in a block because the channels and orifices of the blocks vary from about ⅛ inch to about 5/16 inch diameter. Also, just as the piston begins to open or close, in one of the ports the opening will be very small and, consequently, the shear rate there will be very high.

After selecting suitable scales for the flow rate and apparent viscosity, constant pressure lines were drawn from a given flow rate to the various apparent viscosity values representing that pressure drop. The intersection of these constant pressure drop lines located the pressure drop scale.[1]

OTHER LABORATORY METHODS FOR PREDICTING PUMPABILITY

Various manufacturers of dispensing equipment have established bench tests which they feel gives them an idea of how a grease will function in their equipment. Such tests are, of course, of considerable interest to the petroleum research laboratory and work has been done to duplicate and investigate these procedures. Two such methods, arbitrarily designated Pumpability Test A and Pumpability Test B, have been of particular interest and will be discussed in detail.

Pumpability Test A

A product was considered satisfactory if two ounces per minute could be delivered through 25 feet of standard ¼ inch copper tubing wound into an 18 inch helical coil with the pressure not to exceed 2000 psi when the temperature was 0°F.

The test equipment shown in Figure 15 consisted of a 1725 RPM, ¼ h.p. motor which was used to drive a variable speed transmission, which in turn drove an oil pump supplying hydraulic oil pressure to the oil side of a free floating piston in a grease cylinder. The copper tubing was connected to the grease cylinder. A pressure gage was used to measure the pressure of the grease as it left the cylinder. The pressure observed was the pressure drop in the tubing since the tubing discharged at atmospheric pressure. A thermocouple was inserted directly behind the connection for the pressure gage for measuring the grease temperature. The entire assembly was enclosed in an insulated box in which the ambient air temperature of the box could be closely controlled.

To conduct the test, the grease cylinder was filled with the test grease and placed in the cold box. After connecting the copper tubing, the cold

[1] The foregoing laboratory work was completely covered in a paper "Predicting Pressure Drops In Grease Distribution Equipment" by E. F. Koenig, E. M. Johnson and E. A. Baniak presented at the 1955 Annual NLGI Meeting symposium on flow properties of lubricating greases.

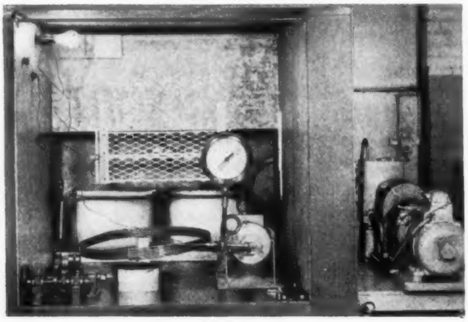


Figure 15 — Apparatus for Pumpability Test A.

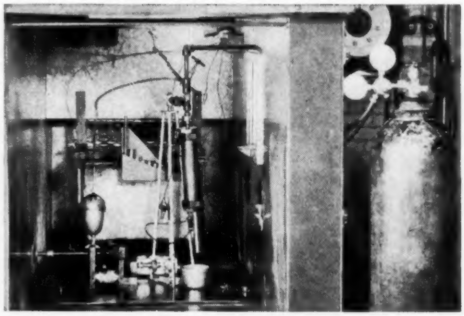


Figure 17 — Apparatus for Pumpability Test B.

box was brought to test temperature and the apparatus was allowed to soak at that temperature to insure a uniform temperature throughout the grease. The electric motor was then started and the grease was allowed to pump until flow equilibrium was obtained and the pressure became stabilized. The pressure and temperature were recorded and the flow rate was determined by catching and weighing the grease pumped during a timed interval. Three flow rate determinations, straddling two ounces per minute delivery, were made at each test temperature. The temperature range covered was from room temperature down to the temperature at which 2000 psi pressure was required for a delivery rate of two ounces per minute. The three delivery rates obtained for each test temperature were plotted against their respective pressures. The pressure required for two ounces per minute delivery at each test temperature was then obtained for each grease tested from such a family of curves. The relation between temperature and required pressure for several greases tested is shown in Figure 16.

Pumpability Test B

In conducting this test, a nitrogen cylinder controlled by a high pressure regulator was used to

Figure 16 — Results for several greases evaluated in Pumpability Test A.

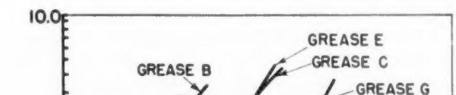


Figure 18 — Results for several greases evaluated in Pumpability Test B.

TABLE II

Greases Tested in Pumpability Tests A and B

Grease	Worked Penetration	Soap Type	Soap Per Cent	Oil Component Viscosity SUS At 100°F	Oil Component Viscosity SUS At 210°F
A	375	Ca	7.1	330	53.7
B	337	Ca	10.7	330	53.7
C	363	Ca	10.9	453	55.1
D	322	Ca	12.5	1092	78.2
E	374	Ca,Pb	10.7,0.87	326	52.5
F	308	Ca,Pb	16.1,3.4	1029	69.2
G	320	Ca,Pb	5.8,2.1	1569	102

apply pressure to the upper side of a free floating piston in a grease pressure cylinder. A capillary, 0.152 inches in diameter with approximately a 40-1 length to diameter ratio, was connected to the grease pressure cylinder. The grease cylinder and capillary were enclosed in the same insulated box used for Pumpability Test A. The test apparatus is illustrated in Figure 17.

The grease pressure cylinder was filled with the test grease and placed in the cold box to soak at the test temperature. The capillary, which had been stored in the cold box, was then screwed into the bottom of the grease cylinder. The valve was then opened and the nitrogen pressure forced the grease through the capillary. A constant nitrogen pressure of 150 psi was used with each grease and for each test temperature. The flow rate was obtained at each test temperature over a range from approximately 77 to −30°F. The criteria for performance was that a grease must show a flow rate up to 1.0 grams per second at 0°F. Curves illustrating the relation between temperature and flow rate for several greases are shown in Figure 18.

Comparison of Results From Pumpability Tests A and B

A number of greases were tested by each procedure. For those greases that were tested in both methods, there was good qualitative agreement. Greases rating from best to worst in one method were also rated in the same order in the second method. The actual temperature at which two ounces per minute flow was obtained in each method did not necessarily agree, but each test indicated the same relative ease of pumpability. A comparison of the relative order of pumpability for the greases tested by each procedure is shown in Table III. It should be noted that the relative performance does not correlate exactly with any one grease characteristic. In general, greases having the lower viscosity oily component gave the best pumpability. It is apparent, however, from the typical tests shown on these greases in Table II and the relative order of performance shown in Table III, that the con-

TABLE III

Comparison of the Relative Order of Pumpability for Greases Tested by Pumpability Tests A and B

Grease	Temperature For 2 oz./min. Flow, °F Pumpability Test A	Pumpability Test B
A	−9	−12
B	16	−2
E	22	17
C	25	14
G	38	30
D	55	40
F	67	70

sistency, type and per cent soap, and oil component viscosity all have an influence on pumpability.

OTHER CONSIDERATIONS

As mentioned above, there are several grease characteristics that can affect the performance of a grease in dispensing equipment. First of all, the grease must have good slumpability characteristics. This may be considered as the ability of the grease to flow in the container under gravity and suction head and maintain a seal at the pump inlet. The use of a properly designed follower plate or provision for positive feed to the suction side of the pump can minimize or eliminate the importance of slumpability. Another factor which would affect the flow to the pump is the grease consistency. Consistency based upon both worked and unworked penetrations must be considered. If left undisturbed, certain greases will harden excessively with time. If they are then subjected to a shearing action they will soften to approximately their original consistency. If then left undisturbed, they again harden. This behavior is known as thixotropy. A grease having these characteristics might give considerable trouble in a dispensing system. Unworked penetrations on storage samples will give a warning of this behavior.

Flow From The Pump

Flow of grease on the high pressure side of the system is dependent on many factors. Some of these factors are the mineral oil viscosity, consistency, additives, and grease temperature. All other things being equal, the rate at which a grease can be dispensed decreases as the viscosity of the oil contained in the grease increases. In other words, for two greases of the same consistency and having similar soap contents, the grease having the lower oil viscosity component would be expected to give the best pumpability performance.

Consistency

In general, soft greases can be dispensed more easily than hard greases. This does not mean, however, that two greases of equivalent consistency can be pumped equally well. Other grease characteristics must be considered. Unfortunately, the desired characteristics of a high viscosity oil component to increase the ability of the grease to be retained on the bearings conflicts with the desirable characteristics of a soft grease and low viscosity oil component for good ease of pumpability. Obviously there must be a compromise to provide the most satisfactory product.

Structure

Certain greases are fiberous or stringy in nature and will not pump as well as buttery type greases. Here again a compromise must sometimes be made to use the grease that will give the most satisfactory lubrication performance, yet still be capable of being pumped.

Temperature

Another factor to consider is the low temperature characteristics of the grease. Lubricating greases, like all petroleum products, become more viscous as the temperature is lowered. A change in temperature might have more effect on the pumpability of one grease than it would have on another grease. For example, two greases might give entirely satisfactory pumpability performance at 77°F. At some lower temperature, say 30°F., Grease A might still be giving completely satisfactory pumpability and yet Grease B would fail to pump.

Apparent viscosity data obtained at the expected operating temperatures for the greases of interest will usually provide a good indication of their expected performance.

Oil Separation

Oil separation of grease has been a problem in some installations, particularly if vibration and/or long residence times are involved. While some oil bleeding is beneficial for lubricating bearings, excessive bleeding at the metering valves and orifices will leave a soap rich fraction that will cause partial or complete restriction to grease flow. Many laboratory methods have been devised to determine the oil bleeding characteristics of greases. In general, each of these tests measures the amount of oil separated after a specified time, at specified temperatures and pressures, in a specified container. The oil separation tendencies have been found to depend on the grease structure, type and per cent soap, viscosity of the oil component and most of all on the design of test apparatus used. Some tests do indeed give excellent repeatability and provide useful information on oil separating characteristics, but correlation of these results with field applications is often difficult.

SUMMARY

Automatic grease dispensing equipment of many designs is available for providing positive and optimum lubrication in industrial equipment. These automatic systems have played an important role in enabling the use of machinery to attain present-day speeds and precision.

Satisfactory operation is also dependent on the choice of the proper lubricant. Controlled laboratory tests have been useful to obtain predicted performance data of greases in centralized lubrication systems.

Printed in U. S. A. by
Salley & Collins, Inc.
305 East 45th Street
New York 17, N. Y.

ONE FOR ALL *...and down come lubrication costs!*

ONE GREASE—*Texaco Multifak*—can handle your grease lubrication jobs. Think how this can simplify your lubrication, reduce your lubricant inventory, save you time and money!

Texaco Multifak is a lithium-base grease that is ideal for both anti-friction and sleeve-type bearings. In addition to reducing wear and assuring smoother operation, *Texaco Multifak* offers these advantages: it pumps easily at low temperatures, stays *in* the bearings even when temperatures get up to 250° F. or more, has exceptionally high stability and resistance to oxidation.

And to lubricate your diesel engines, use one of the famous *Texaco Ursa Oils*. There's a complete line of them especially refined and processed to assure *more power* with *less fuel* and *longer periods* between overhauls.

Ask your Texaco Man to show you how you can put Texaco to work improving your operation. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

☆ ☆ ☆

The Texas Company, 135 East 42nd Street, New York 17, N.Y.

TEXACO

TEXACO Lubricants and Fuels

FOR COTTON GINS AND OIL MILLS

10,000,000TH MAYTAG WASHER to come off the line at Newton, Iowa, plant.

Texaco helps assure in-use dependability for Maytag

The Maytag Company knows the importance of effective lubrication in keeping its appliances working dependably through years of washdays —and for more than twenty years Texaco has helped to deliver it.

Maytag Washers and Dryers are Texaco-lubricated when they leave the factory. And Texaco Lubrication Engineers work closely with Maytag Engineers on the lubrication requirements of new appliances—right from the initial design stage.

Texaco Lubrication Engineering Service can be helpful to you, too. Use it to assure the dependable performance of your product in the field.

Use it to help make your product—increase production, reduce unit costs.

Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

THE TEXAS COMPANY • • • DIVISION OFFICES

ATLANTA, GA.....864 W. Peachtree St., N.W.
BOSTON 16, MASS.......20 Providence Street
BUFFALO 5, N. Y...............P.O. Box 368
BUTTE, MONT.........220 North Alaska Street
CHICAGO 4, ILL.....332 So. Michigan Avenue
DALLAS 2, TEX.......311 South Akard Street
DENVER 3, COLO..........1570 Grant Street
HOUSTON 2, TEX......720 San Jacinto Street
INDIANAPOLIS 1, IND., 3521 E. Michigan Street
LOS ANGELES 15, CAL....929 South Broadway
MINNEAPOLIS 3, MINN....1730 Clifton Place
NEW ORLEANS 16, LA......1501 Canal Street
NEW YORK 17, N. Y.....205 East 42nd Street
NORFOLK 2, VA.....3300 E. Princess Anne Rd.
SEATTLE 1, WASH..........1511 Third Avenue

Texaco Petroleum Products are manufactured and distributed in Canada by McColl-Frontenac Oil Company Limited.